EVALUATING FIBER PROPERTIES IN VERTICILLIUM WILT SUSCEPTIBLE AND RESISTANT COTTON CULTIVARS IN RELATION TO INCREASING NITROGEN RATES

C. R. Albers
Texas Tech University
Lubbock, TX
J. E. Woodward
Texas A&M AgriLIFE Extension Service
Lubbock, TX
P. A. Dotray
Texas Tech University
Lubbock, TX
E. C. Best
Monsanto, Deltapine Co.
Lubbock, TX
D. J. Jost
Monsanto, Deltapine Co.
St. Lawrence, TX
J. G. Smith
Texas A&M AgriLIFE Extension Service
Lubbock, TX

Abstract

Field studies were conducted in 2011 and 2012 growing season to evaluate the effect of increasing nitrogen rates (0-250 lb/A) on disease incidence, lint yield and fiber quality of varieties (Deltapine 0912 B2RF, Deltapine 104 B2RF, Fibermax 9160 B2F and Deltapine 1032 B2RF). Drought conditions throughout the 2011 and 2012 growing season negatively affected all agronomic factors measured in this test. The application of nitrogen did not resulted in taller plants or an increased number of nodes from the non treated control. Foliar symptoms of Verticillium wilt were observed at one of the locations, and the application of nitrogen generally increased disease incidence. Lint yields were increased with the application of nitrogen over the non-treated control; however, differences between the application rates were not observed. Lint yields in 2011 were greatest for DP 0912B2RF and a reduction in yield for the other three varieties. In 2012, all yields were greatly increased, with DP0912 B2RF, FM9160 B2F, and DP1032 B2RF all yielding closely to each other. Subtle differences in fiber quality parameters were observed for the varying nitrogen rates; while varietal effects were observed for most parameters when analyzing the years separately and combined.

Introduction

Verticillium wilt, caused by the soilborne fungus *Verticillium dahliae* Kleb, is an economically important disease of cotton on the Texas South Plains (Woodward and Wheeler, 2009). According to Bell (1992), the fungus is capable of surviving long periods of time in the soil as microsclerotia. The effects of cultural practices including crop rotation, proper irrigation, (Wheeler et al., 2012) and plant populations (Wheeler et al., 2010) on disease incidence are well known. There are no registered chemical control options for Verticillium wilt in cotton. Currently, the disease is managed through the use of partially resistant and/or tolerant varieties. Chawla et al. (2012) demonstrated that variety selection impacted densities of microsclerotia. Various production practices, including nitrogen fertility, affect disease development in other crops (Rowe and Powelson, 2002); however, information between nitrogen fertility and Verticillium wilt in cotton is lacking. The objective of this study was to examine the influence of nitrogen on disease incidence, lint yield and fiber quality of susceptible and partially resistant cotton cultivars. Preliminary findings were previously reported (Albers et al., 2012).

Materials and Methods

Trials were conducted in fields infested with low to moderate levels of *V. dahliae*. Two trials were established in fields with sub-surface drip irrigation at the Texas Tech New Deal Research Farm (Lubbock, Co.) and the Texas Tech Quaker Research Farm (Lubbock, Co.). Separate studies were conducted under center pivot irrigation at the Texas AgriLIFE Research Halfway Station (Hale, Co.). The experimental design was a split-plot where nitrogen

rates (0, 50, 100, 150, 200 and 250) served as whole plots, and cotton varieties (Deltapine 0912B2RF, Deltapine 104B2RF, Fibermax 9160B2F, and DP1032 B2RF) served as sub-plots. The varieties were chosen because of their maturity and susceptibility to Verticillium wilt (Table 1). Treatments were arranged in a randomized complete block with four replications. Urea Ammonium Nitrate served as the nitrogen source and was applied prior to bloom. Stand counts were made approximately 30 days after planting. Disease incidence, plant height and total nodes were assessed throughout the season. Vascular discoloration was determined by destructively sampling five plants, and looking for discoloration. Lint yields were determined for each plot and sub-samples were ginned and submitted the HVI analysis at the Texas Tech University, Fiber and Biopolymer Institute. Statistical comparisons were made using Proc Glimmix and means were separated using Fisher's Protected LSD ($P \leq 0.05$).

Results and Discussion

Temperature and rainfall was well below average throughout most of the growing season (data not shown). Neither plant height nor the number of total nodes was affected by nitrogen rates; however, differences were observed among varieties (Figure 1). Heights were greatest for DP 0912B2RF and DP 1032 B2RF at 26.9 and 26.7 inches, respectively. The number of nodes followed a similar trend as plant height. A significantly higher number of nodes were observed for FM 9160B2F compared to other varieties, which can be explained by the higher fruiting habit of this variety. Despite poor growing conditions, significant differences in disease incidence were observed among the nitrogen rates and varieties. Appreciable levels of Verticillium wilt symptoms were observed only at the Halfway1; therefore, those data are presented independently (Figure 2). Overall, disease incidence was greater for higher nitrogen rates (150-250 lb/A) than lower rates (0-100 lb/A). The higher levels of nitrogen applied may have led to an increased demand for water and nutrient uptake, favoring colonization of the vascular system by *V. dahliae*. There were higher levels of disease observed in both susceptible varieties (DP 0912B2RF and DP 1032B2RF) compared to the partially resistant varieties (FM 9160B2F and DP 104B2RF). While disease incidence levels at this location were much less than what has been observed previous years (Woodward, *unpublished*), the addition of nitrogen generally resulted in increased incidence of foliar symptoms.

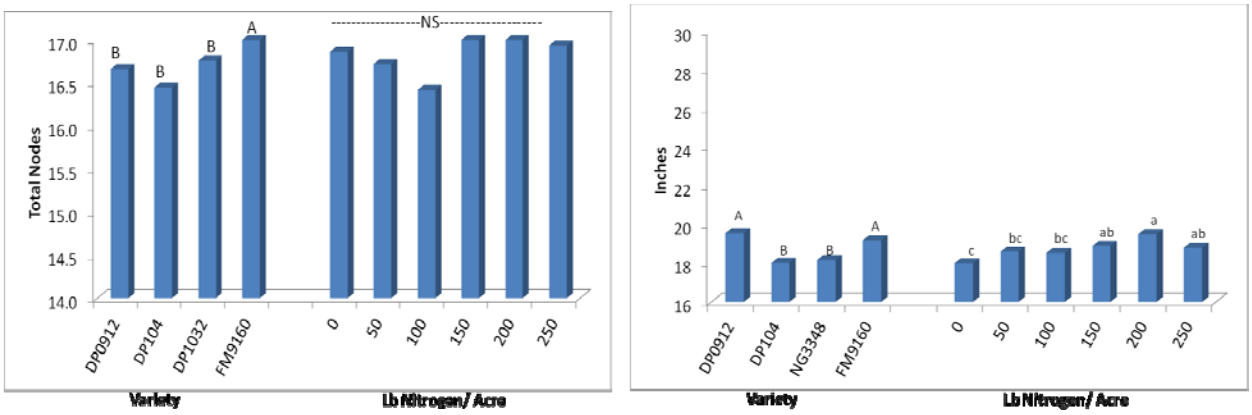

Figure 1. Effect of increasing nitrogen rates on total nodes (top) and height (bottom) of four cotton varieties in 2012. Bars with the same letter are not different according to Fisher's Protected LSD ($P \leq 0.05$).

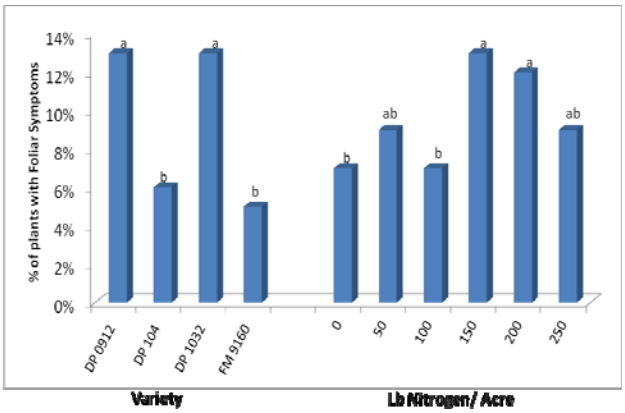

Figure 2. Verticillium wilt incidence of four cotton varieties and six nitrogen rates at the 2012 Halfway #1 location (N=16). Bars with the same letter are not different according to Fisher's Protected LSD ($P \leq 0.05$).

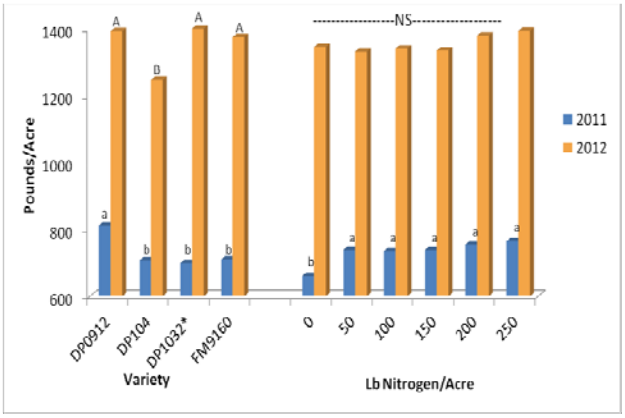

Figure 3. Lint yield as affected by cotton variety and nitrogen rates over two years in the Texas High Plains. Data are combined across trials within a year (n=16). Bars with the same letter are not different according to Fisher's Protected LSD ($P \leq 0.05$). *The variety DP 1032B2RF replaced NG 3348B2RF at all locations in 2012.

Differences in yield were observed between the two years this study was conducted (Figure 3). Yields were greatest for DP 9012B2RF in 2011. The application of nitrogen improved lint yields approximately 85 lb/A over the non-treated control for 2011; however, yields were similar for all nitrogen applications. In 2012, yields averaged over 1300 lb/A and were similar for all varieties, except DP 104B2RF. Nitrogen rate had no affect on yield. Subtle differences in fiber quality parameters were observed for the differing nitrogen levels (Table 2). Higher nitrogen rates resulted in higher strength values. Excessive nitrogen fertility has been shown to negatively affect micronaire in Texas (Parajulee et al., 2010); however, the highest micronaire was achieved with highest nitrogen rate. The majority of differences in fiber quality parameters were observed between varieties (Table 2). Micronaire, Uniformity, Strength and Elongation values were greatest for DP 0912B2RF, FM 9160B2F, DP 104B2RF and DP 104B2RF, respectively.

Table 1. Characteristics of varieties included in field studies.

Variety*	Maturity	Verticillium wilt reaction
FiberMax 9160 B2F	Medium	Partially resistant
NexGen 3348 B2RF	Medium	Susceptible
Deltapine 1032 B2RF	Medium	Susceptible
Deltapine 104 B2RF	Early	Partially resistant
Deltapine 0912 B2RF	Early	Susceptible

* NexGen 3348 B2RF was tested in 2011 and replaced with Deltapine 1032 B2RF in 2012.

Table 2. Effect of nitrogen and cotton variety on several fiber quality parameters for both 2011 and 2012.

Factor, level	Micronaire		Length		Strength		Uniformity	
DP0912	4.6	a	1.03	c	28.3	c	80.5	b
DP1032	3.9	b	1.07	ab	30.0	d	81.0	bc
DP104	4.3	ab	1.08	b	28.9	a	80.3	a
NG3348	4.0	b	1.05	bc	28.4	cd	80.2	c
FM9160	4.1	b	1.09	a	29.3	b	81.1	a
0	4.2	ab	1.06		28.9	ab	80.6	ab
50	4.1	bc	1.07		29.0	ab	80.7	ab
100	4.2	a	1.06	NS	28.8	b	80.5	ab
150	4.2	abc	1.07		29.1	a	80.7	ab
200	4.1	c	1.07		29.0	a	80.5	b
250	4.2	ab	1.07		29.1	a	80.7	a

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